2.2.9

B.E. (Civil) 5th Semester Examination, January 2009

ENVIRONMENTAL ENGINEERING – I
(CE 504)

Time : 3 hours | Full Marks : 70

Assume any data, if required, reasonably
Use separate answer-script for each half

FIRST HALF

(One mark is reserved for neatness)
Answer question no. 1 and any 2 (two) from the first half

1. Write short notes (any four) on the following: $(2^1/_2 \times 4)$

   (a) Disinfection of drinking water by ozone

   (b) Coliform bacteria

   (c) Sources of arsenic in ground water of in lower Ganga Plain

   (d) Population calculation in metro cities by zoning method

   (e) Methods of drilling of tube-well

   (f) Basic principle of coagulation

2. (a) What are the factors affecting the total water demand for a city like Kolkata? What is the significance of peak factor in water supply? How population affects peak factor? (6)

   (b) Deduce the equation for 'incremental increase method' of population projection and with this method, solve the following problem.

   The population of a town as per the Census records are given below for the years 1941 to 2001. Assuming that the scheme of water supply will commence to function from 2009, it is required to estimate the population of 30 years and also the intermediate population of 15 years after 2009.

Year	1941	1951	1961	1971	1981	1991	2001
Population	25,000	27,500	34,100	41,500	47,050	54,500	61,000

(6)

3. (a) What are the quality parameters for drinking water? (3)

   (b) What are the Indian Standards of drinking water for fluoride? What are the health impacts of fluoride? Write in brief about the fluoride problem in Indian ground water. (5)

   (c) A sample of water from the overflow of the recarbonation basin that follows a precipitation/softening process has a pH of 9.0; 200 mL of the water require 3.1 mL of 0.02 N H_2SO_4 to titrate it to the phenolphthalein endpoint and additional 22.9 mL of 0.02 N H_2SO_4 to titrate it further to the orange endpoint. Assuming the sample contains no calcite particles, what are phenolphthalein alkalinity and the total alkalinity in mg/L as $CaCO_3$? At what concentration of different 'alkalinity causing species' are present in the sample? (4)

4. (a) What are the different types of sedimentation? Distinguish between type I sedimentation and type II sedimentation with settling profile. (4)

(b) Capacity of the water treatment plant is 2 MLD. The particle size distribution shows that 0.2 mm dia. (100 ppm); 0.09 mm dia. (70 ppm); and 0.05 mm dia. (50ppm) are present in the raw water. Two plain sedimentation tanks are designed considering 100% removal of 0.09 mm dia. particle. Find out the size of the sedimentation tanks, detention period, overflow rate and amount of sludge (volume and weight) generated per day.

Given: Sp.Gr. of particle 2.65; $\mu = 1.002 \times 10^{-3}$ N.s/m^2 ; 2% solids (w/w) in sludge (6)

(c) Size of bars of a manually cleaned screen chamber is 10 mm × 75 mm and spacing between bars is 60 mm. Velocity through screen is 0.8 m/s. Find the amount of head loss when the screen is half clogged. (2)

5. (a) In a coagulation–sedimentation unit of a 20 MLD capacity water treatment plant, alum dose is 17 mg/l. If the raw water is having pH 8 and an alkalinity equivalent to 4 mg/l as $CaCO_3$, determine the amount of alum and quick lime (80% pure) required per day by the plant. (M.W. of Al = 27). Amount of suspended solids at inlet and outlet are 40 ppm and 12 ppm. Find out the amount of sludge produced (volume and weight) if sp.gr. of solids 2.9 and solids concentration in sludge is 1.3%. (6)

(b) Describe the different features of rapid sand filter. How under drainage systems are designed for rapid sand filter? (6)

6. (a) In a 10 MLD capacity water treatment plant hardness is removed by lime-soda process. Considering the characteristics of water, before softening, given below, find out the amount of lime and soda required per day.

Water composition: Ca^{2+} = 99 mg/L ; HCO_3^- = 245 mg/L ; Mg^{2+} = 15 mg/L ;
SO_4^{2-} = 55 mg/L ; Na^+ = 28 mg/L ; Cl^- = 70 mg/L .
concentration of CO_2 (g) = 19.5 mg/L and pH = 7.6. (5)

(b) What are the different types of disinfectants available for treating drinking water? Describe the use of chlorine as a disinfectant for the treatment of drinking water. What is break point chlorine dose? (5)

(c) In chlorination, residual free chlorine concentration after 20 minutes of contact period is 0.2 mg/l at break point chlorine dose of 1.1 mg/l. When applied chlorine

dose is 1.6 mg/l then what will be the chlorine demand and residual free chlorine with same contact period? (2)

SECOND HALF

(Two marks are reserved for neatness)
Answer any three questions

7. (a) Draw a flow diagram of a wastewater treatment plant using activated sludge process (indicating the flow of sewage as well as sludge and also show the location of equalisation tank).

(b) How a grit chamber differs from primary settling tank in wastewater treatment plant? Why velocity control is helpful for grit chamber?

(c) How is the installation of equalisation tank helpful?

(5+3+3)

8. (a) What is BOD? Distinguish between carbonaceous and nitrogenous BOD.

(b) How the organic and inorganic solids in a wastewater sample are normally estimated? Mention the procedure briefly.

(c) The BOD of a sewage incubated for one day at 30C has been found to be 100 mg/L. What will be the 5-day 20C BOD. Assume K = 0.12 d-1 (base 10) at 20°C.

(4+4+3)

9. (a) Discuss some of the factors that may govern the choice of a separate system of sewerage.

(b) Write a note on 'time of concentration' and its significance in determining the storm water flow.

(c) What is the 'self-cleansing velocity' in a sewer? Why a maximum velocity is recommended for the sewers?

(4+3+4)

10. (a) Discuss the functioning of a trickling filter.

(b) How treatment of faecal waste is achieved in a septic tank? Show the construction of septic tank with a diagram.

(c) How anaerobic digestion helps to stabilise the organic sludge?

(3+4+4)

11. (a) What do you understand by self-purification property of stream?

(b) A wastewater treatment plant disposes off its effluents into a stream at a point A. Characteristics of the stream at a location fairly upstream of A and of the effluent are as follows:

Item	**Unit**	**Effluent**	**Stream**
Flow	m^3/s	0.16	0.4
Dissolved oxygen	mg/L	1.60	8.20
Temperature	°C	25	22
BOD_5 at 20°C	mg/L	32	2.0

Assume that the deoxygenation constant at 20°C (base e) = 0.2 d^{-1} and reaeration constant at 20°C = 0.4 d^{-1} for the mixture. Saturation concentration of dissolved oxygen for fresh water is as follows:

Temp (°C)	18	20	22	23	24
C_s (mg/L)	9.54	9.17	8.99	8.83	8.53

The velocity of the stream downstream of the point A is 0.16 m/s. Determine thye critical oxygen deficit and its location.

(3+8)